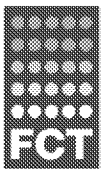

Water Treatment

www.FCTWater.com

Proposal for
Consulting Services Agreement

Nebraska Public Power District
Gerald Gentleman Station
Sutherland, NE

for

Design and Implementation of
Waste Water Re-Use Treatment Plan

April 13, 2012

FCT Water Treatment is a recognized leader in water treatment technology in the utility, oil refining and chemical manufacturing industry. Formed by experienced *professionals*, FCT works with clients to provide cost effective, technically sound solutions.

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1.0 Scope and Deliverables

It is the intention of NPPD GGS to develop an integrated and comprehensive **Waste Water Re-Use Plan** with the goal of reducing environmental impact and water consumption on a plant-wide basis and including provision for the future limestone scrubber systems.

Phase One will address the potential for treatment and re-use and reduction of consumption of water for all systems having a water requirement within the plants. Chemistries, equipment, operating requirements, variability and costs associated with water re-use and reduction will be investigated for each system and opportunities for integration explored. Including but not limited to:

- Boiler blow-down recovery and re-use
- Improvement in cooling tower cycles
- Improvement in submerged chain conveyor makeup/overflow rates
- Treatment and re-use of plant service water
- Treatment and re-use of evaporation pond water
- Treatment and re-use of RO reject streams
- Reduction in dust suppression water requirements
- Optimization of water consumption for fly ash wetting
- Solids dewatering requirements and equipment

Phase One will also include:

- Predictive modeling of the chemistry and water balance to determine the impact of produced water quality (composition) and most important, the variability of water quality on the operation of each stage of the proposed waste water system. The predictive modeling will include calculation of scaling indices, corrosion potentials, scrubber recovery efficiencies and solids removal/handling. *Data to be supplied by NPPD.*
- Overview the design of the waste water re-use system based upon the predictive modeling and practical experience with industry best practices. The system design will be comprised of a specification of major equipment components, budgetary cost estimates and overall operational guidelines.
- Overall integration of equipment and treatment flows. Cost associated with re-use of some existing equipment and buildings and comparison to purchase of new.
- Integration will include specifications, estimated time and labor costs and engineering drawings.

Phase One will produce several possible schemes

- FCT will provide recommendations based on flexibility and future needs
- FCT will provide recommendations based on cost per gallon of water treated
- FCT will provide recommendations based on best industry practices

The consulting services provided by FCT Water Treatment are intended to provide guidance and direction and feedback in order to meet the objectives of Phase One

This proposed agreement is for FCT Water Treatment to provide technical consulting services to produce a design, which meets these goals related to basic chemistry, equipment, environmental compliance issues and implementation.

The overall course the consulting services are to perform :

FCT Water Treatment, resultant from this project will deliver to NPPD GGS complete documentation of the predictive modeling, design and operational guidelines for the waste water re-use system. The documentation will be guaranteed to be complete and sufficient to be used as the basis for preparation of mechanical construction, PI&D and control/instrumentation drawings. *Not included in this scope of work are preparation or supply of detailed construction, PI&D and control/instrumentation drawings.*

2.0 Preliminary System Descriptions

The final design produced will be directed by GGS site needs and the findings of Phase One.

A description of typical system components used for wastewater treatment systems – *some of which or all of may be selected for the proposed system* - are summarized below. Also refer to Appendix for basic process flow diagrams for the systems, general equipment list and budgetary estimates.

Wastewater Re-Use Treatment System

The proposed Waste Water Re-Use Treatment System is a Near Zero - or Zero - Liquid Discharge (ZLD) Treatment System. The System will remove or reduce both soluble and non-soluble solids from the wastewater, producing conditioned, solid waste acceptable for onsite storage or off-site disposal and distilled water for reuse.

A typical ZLD System may consist of the following sub-systems. One or more of these treatment steps may be optional based upon the planned final use of the effluent product water:

a. Lime-Soda Softening with solids dewatering
b. Multimedia Pressure Filtration
c. Zeolite Softening - optional
d. Reverse Osmosis (RO) – to be investigated

Lime-Soda Softening System

A Lime-Soda Softening treatment system removes suspended solids from the wastewater and precipitates calcium (Ca), magnesium (Mg), and silica (SiO2). The removal of these suspended solids and ions from the wastewater will produce effluent water of sufficient quality to be used directly as Limestone Scrubber Make-Up or other general plant service water or alternatively to allow a downstream Reverse Osmosis (RO) System to operate at maximum efficiency.

The plant will collect the wastewater from the plant in an effluent tank where it will be homogenized or alternatively in a collection pond. The wastewater will be a mixed and variable composition made up of, but not limited to the following sources:

- Bottom ash water
- Aux. Cooling Tower Blow down
- Zeolite Softeners Regeneration Waste
- Filter Press Filtrate Sump Return
- Plant RO Reject
- Drain run-off
- Boiler Blow-downs

From the effluent tank, the wastewater will be fed to the treatment system. It will first enter the Rapid Mix Tank. The flow to the Rapid Mix Tank is controlled via a flow control valve. Lime and coagulant (Ferric Chloride) are added to the Rapid Mix Tank. Lime is added to raise the pH to induce the precipitation of Calcium Carbonate (CaCO3), Ferric Hydroxide (Fe(OH)3), and Magnesium Hydroxide (Mg(OH)2). The production of the Mg(OH)2 is very important, because SiO2 is absorbed into the Mg(OH)2 particles during the chemical precipitation reaction. The removal of silica will greatly reduce the scaling potential in the downstream limestone scrubber system and, alternatively the downstream RO System, which will allow the RO to operate at a high recovery. Ferric Hydroxide precipitation will aid in the production of stable particles (floc).

The wastewater will then flow into the Clarifier Reactor, where Soda Ash (Na2CO3) and Anionic Polymer will be added. The Soda Ash will induce the precipitation of the remaining soluble Ca++. Again, the replacement of Ca++ ions in the water with Na+ ions will greatly reduce the chances of scaling in the downstream limestone scrubber system and, alternatively of the downstream RO System, which will allow for a high recovery rate (>85%). Polymer is injected into the Clarifier Reactor to aid in the flocculation and settling of the precipitated and coagulated particles.

After leaving the Clarifier Reactor, the chemically treated wastewater will flow into the Clarifier Reactor/Thickener Tank, were the formed solids will separate from the water and settle to the bottom of the tank. The clean water will flow out of the Clarifier Reactor/Thickener Tank via a lamella tube area, which will ensure a low TSS (on average < 5 mg/l) effluent. The settled sludge will be mechanically thickened (on average sludge concentration > 15%) by a scraper rake at the bottom of the tank. A part of the sludge inventory is recycled back to the influent piping to the Clarifier Reactor, thereby increasing the solids in the reactor and improving the performance of the process, especially SiO2 removal. This internal recycling of previously formed solids

(sludge) enhances the solids contact process and increases the speed of the reactions. While a fraction of the sludge is recycled most is wasted to the sludge storage tank, where it is stored and then processed through the solids dewatering system. Lime softening typical produces a 1% (of influent feed rate) by volume sludge stream.

The pH of the produced clarified water may be adjusted with sulfuric acid (H2SO4) as required for the downstream processes.

Lime-Soda System Solids Dewatering System

The sludge in the sludge storage tank is processed through the solids dewatering system on a 7-day/week and 8-hour/day operational basis. The sludge is pumped into one (1) 100% Recessed Chamber Filter Press, where it is dewatered. The estimated sludge cake (dewatered sludge) characteristics will be on average 40% moisture content and density of 90 lbs/ft3. The sludge cake will fall into roll-off bins, which are stationed below. The filtrate from the sludge dewatering process will flow into the Master Sump for storage and recycle. The filtrate will be pumped back to the 3-day Wastewater Equalization Storage Tank to ensure homogenized wastewater.

The recycle of all wastewater back to the Wastewater Equalization Storage Tank is an important element in the overall process. By recycle back to the Wastewater Equalization Storage Tank, instead of the ClarifierReactor, the system ensures that the limestone scrubber make-up, or alternatively the Reverse Osmosis System does not see wide swings in either flow or TDS concentration.

Reverse Osmosis System (optional)

Water from the lime softener is fed from the clear well through multimedia filters to remove particulate matter which may have carried over from the clarifier. This filtered water then passes through polishing zeolite softeners to reduce the hardness of the lime-softened water from approximately 3 grains per gallon to near zero. Sodium bisulfite is injected into the feed water to remove any FAC, which may be present, and then antiscalant is added to inhibit scale formation on the RO membranes. The water is further filtered by 5 µ cartridge filters and is then fed to the RO system.

A single 100% RO is proposed, but 2 x 100% installed pumps are included on the system for redundancy. This RO employs 6 pressure vessels, each containing six
8" by 40" TFC membranes, and these pressure vessels are arranged in 4:2 array. Reject recirculation is used to achieve a 90% recovery. The capacity of the proposed RO will be determined by the GGS requirements. For illustration purposes, when 114 gpm is fed to the RO system, approximately 103 gpm of permeate are produced to be used in the plant, and approximately 11 gpm of concentrated brine is produced.

Downstream treatment, if any, of the concentrated brine will be determined by GGS requirements. One proposal is for use of the produced brine for solids handling in the fly ash system - applied at the existing damp unloading or hydrobin locations. Alternatively, the produced brine could be collected in the crystallizer feed tank and pumped to the crystallizer.

A permeate flush pump skid is also provided. During each shutdown of the RO system and at other preprogrammed times, the membranes on the RO will be flushed with RO permeate to keep them clean and to reduce the potential for mineral scale formation. A clean-in-place system (CIP) is also provided so that the RO elements can be periodically cleaned with high and low pH solutions.

3.0 Proposed Timeline Phase One

1.	Proposal Acceptance	
2.	Kick Off Meeting	Week of April 30, 2012
3.	Review of Existing Data Completed	June1, 2012
4.	Predictive Modeling Completed	June 15, 2012
5.	Design Overview Completed	June 29, 2012
6.	Design Overview Documents Delivery	July 13, 2012
7.	Integration & Phase Two Meeting	Week of July 16, 2012
8.	Integration Documents Delivery	July 27, 2012

4.0 Resources and Cost

FCT Water agrees to provide up to 40 man-days of professional consulting services during the period beginning March 15, 2012 and ending July 1, 2012

Payments NPPD shall pay to FCT Water Treatment a fee of US $2500 per day, (US$250/hour) billed in minimum increments of one hour or part thereof.

The not to exceed total for the proposed work is US $38,000. FCT Water Treatment shall keep records of time spent on NPPD business and send monthly invoices. If the allotment is used up by the end of the Term, FCT Water Treatment may submit invoices for agreed upon hours exceeding the allotment at the rate of US$250 per hour.

A standard FCT Water Treatment Services rate sheet for analytical services and per diem is attached. Discounts or negotiated services fees may apply.

Reimbursement of Expenses. FCT Water Treatment may incur reasonable and pre-approved expenses including travel and other agreed upon items. Expenses shall be reimbursed within thirty (30) days of FCT Water presenting NPPD with an itemized account of the expenditures.

Expenses may include, but not be limited to analytical/metallurgical services performed by FCT Water Treatment, travel to other than GGS plant site and pre-approved subcontracted services.

5.0 Services and Personnel

Services provided to NPPD may include technical consulting, engineering/design specifications, mathematical modeling of water systems and water use balance, training, inspections and other items agreed upon.

Unless otherwise agreed upon by both parties, FCT Water Treatment personnel will provide all consulting services as part of this proposed agreement.

6.0 Terms and Confidentiality

Confidential Information. For purposes of this agreement Confidential Information means any information, however transmitted or disclosed by NPPD to FCT Water Treatment including but not limited to:

a. Records, receipts, specifications, analyses, studies, engineering data, models, proposals, notes, memoranda and interpretations related to NPPD business.

b. Commercial, contractual, legal and financial information pertaining to NPPD business, including but not limited to contracts, proposals, models, marketing analyses, market plans, investment and project development agreements, letters of intent, memoranda of understanding and budgets.

c. Trade secrets, including but not limited to application trade secrets.

In consideration of the covenants and obligations contained herein, FCT Water Treatment agrees that all Confidential Information shall be kept strictly confidential and shall not be sold, traded, published or otherwise disclosed to any person or entity without the explicit written approval of NPPD. FCT Water Treatment further agrees not to reproduce any Confidential Information without the written consent of NPPD. FCT Water Treatment further agrees that it shall safeguard and protect all Confidential Information received as part of this agreement and take all reasonable steps to maintain the confidentiality of any Confidential Information disclosed by NPPD.

This Agreement shall be construed and interpreted in accordance with the laws of the state of Nebraska.

All disputes between FCT Water Treatment and NPPD will be subject to binding arbitration in NPPD Company specifically agree that any arbitration between parties shall take place in Nebraska.

This Agreement inures to the benefit of, and is binding upon the respective successors of the parties.

This Agreement is not assignable.

Signed this _____ day of _____, 2012

NPPD _____

By _____

Title _____

FCT Water Treatment, Inc.

By _____

Title_____

Appendix I - Water Chemistry and Water Balance Data

Appendix II - Process Flow Diagrams

Appendix II – Rate Sheet